REMARKS

In the Specification, paragraph 0015 was amended to correct a typographical error. No new matter has been added.

Claims 1-53 are currently pending in this application. Claims 1-53 have been rejected. Claims 1-6, 15 and 28 have been amended.

I. Rejection of Claims under 35 U.S.C. 102(b).

Claims 1, 3, 4, 7, 10, 12-15, 17, 18, 21, 25-28, 30-31, 33, 36-37, 39-41, 43-44, 46, and 49-53 have been rejected under 35 U.S.C. 102(b) as being anticipated by Harada, *et al.* (5,913,248).

Independent Claims 1 and 43, as well as amended independent Claims 15 and 28, disclose a method for detecting the occurrence of surge or incipient surge in a centrifugal compressor measuring characteristics of or detecting changes in the local fluid flow in a recirculation zone in the inlet passage, proximate to the inlet passage wall and proximate to the impeller. The invention does not attempt to detect incipient surge through measuring bulk parameters, such as bulk flow rate, flow speed or pressure. The invention is the first apparatus and method to recognize and teach detection of fluid flow velocity changes in a local recirculation zone near the inlet passage wall at or near the impeller. The invention does not attempt to detect a flow reversal or flow rate change across the compressor, but is limited by its claim language to detecting changes of flow velocity in a recirculation zone, described in the Specification at ¶18 as "the area within the inlet passage where normal flow conditions will undergo substantial changes prior to the occurrence of surge." Applicant is the first to teach such a solution to detecting incipient surge. The measurement of flow velocity in this recirculation zone, whether as a slowing of velocity, change in direction or flow reversal, at or near the impeller entrance is unique to applicant.

In contrast to the present invention, Harada's sensors fail to measure the local fluid flow velocity in a recirculation zone in the inlet passage proximate to the inlet passage wall and proximate to the impeller as in Claim 1 of the present invention. Harada teaches that, during surge, a vibration occurs in the pump piping and/or machinery. "When the flow rate is decreased below the design rate, large pressure fluctuations are observed, initially in the diffuser...[then] in the pipes...indicating surge is taking place." Col. 2, ll. 36-41; also see Col. 3, ll. 4-6; Col. 8, ll.

28-31. Using this knowledge, Harada teaches detecting the pressure changes to detect surge. Harada does not teach the presence of changes in flow velocity at any specific location. In fact, Harada does not even suggest the presence of a recirculation zone at or near the impeller and inlet wall, and therefore cannot be said to teach the present invention as claimed. Harada does not teach of any localized flow velocity change prior to surge.

Harada does not measure flow velocity at a localized area at or near the impeller. The pressure sensors placed at the locations shown in Figure 5 of Harada will not be capable of measuring the local fluid flow in the inlet passage located proximate the inlet passage wall and impeller. Harada's references to flow rate and flow speed are directed to bulk flow rates and speeds (Column 6, lines 50-51; see Col. 11, line 64 – Col. 12, line 3, "the inlet flow rate *to the pump*") and do not measure a local reading in a recirculation zone. Harada does not even recognize the existence of such a zone, much less the measurement of fluid velocity at that zone. Nor does the fact that Harada mentions the words "tangential component" mean that it teaches detecting changes in the tangential component of fluid velocity in the recirculation zone as taught and required by applicant's Claim 3. In fact, Harada is referring to the calculation of tangential speeds using mathematical equations, inferred from basic principals, rather than actually measured. Harada uses the tangential components of "absolute velocity" to determine the Head (pressure) value for the pump. Harada measures the tangential component at the impeller inlet (noted as Cu-2) and at the impeller inlet (noted as Cu-1) (Col. 12, lines61-67). Harada teaches that the tangential component at the impeller inlet "Cu-1" is "zero" (Col. 13, lines 10-15). Assuming arguendo that Harada is referring to measuring fluid velocity at the recirculation zone (which applicant does not admit), this is in direct opposition to the teaching of applicant that, prior to surge, fluid velocity in the recirculation zone will typically experience an increase in tangential flow (in any case, not zero). Spec., ¶18. Claim 3 requires the measurement of the tangential velocity flow. This further points out that Harada does not teach any recirculation zone as required by applicant's claims.

II. Rejection of Claims under 35 U.S.C. 103(a).

Claims 2, 5, 6, 9, 11, 16, 19, 20, 23, 24, 29, 32, 35, 58, 42, 45, 47, 48 and 52 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Harada, *et al.* ('248) in view of Gaston (4,594, 051).

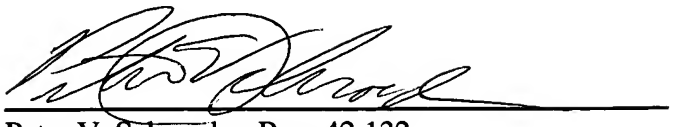
Harada does not teach the limitations of applicant's claims as explained above. The applicant has noted and used, for the first time, knowledge that the occurrence of a small, localized recirculation zone at or near the inlet passage wall, inside of the compressor, and proximate the impeller, can be used to determine an on-coming compressor surge. Harada does not even recognize such a zone exists and does not teach the measurement of fluid flow velocity in that zone. Since Harada does not teach applicant's independent claims, the dependent claims are allowable as depending from allowable independent claims. Additionally, Gaston does not teach applicant's invention either alone or in combination with Harada.

Gaston fails to teach or suggest measuring the internal fluid flow in the inlet passage in a recirculation zone or proximate the impeller and inlet wall, as recited by the independent claims of the present invention. This is evident by Gaston's discussion of the flow reversal, which refers to the reversal of the entire fluid flow that occurs during surge at the *point of discharge*. Col. 1, lines 19-26. This is not a reference to changes in fluid flow velocity in the inlet passage proximate to the inlet passage wall and proximate to the impeller (Col. 1, line 24). This flow reversal is distinct from the measurement of flow reversal, as in some independent Claims, in the recirculation zone of applicant's invention. Nowhere does Gaston recognize a recirculation zone at all, much less refer to taking measurements of any kind in such a zone. Gaston's use of temperature measurements does not meet the requirements of applicant's invention.

Claims 8, 22, and 34 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Harada, *et al.* ('248) in view of Gunn, *et al.* (5,224,836). The comments regarding the limitations of Harada's teaching from above apply here as well. Harada does not recognize a recirculation zone and does not teach the measurement of fluid flow velocity in that zone. Since Harada does not teach applicant's independent claims, the dependent claims are allowable as depending from allowable independent claims. Additionally, Gunn does not teach applicant's invention either alone or in combination with Harada.

For these reasons, the Claims are believed to be in condition for allowance. Reconsideration and further examination is respectfully requested. Applicants have made a diligent effort to place the claims in condition for allowance. However, should there remain unresolved issues that require adverse action, it is respectfully requested that the Examiner telephone Peter V. Schroeder, Attorney, at 214-220-0444 so that such issues may be resolved as expeditiously as possible.

Respectfully submitted,



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